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Experimental Design for the Area 8, Phase I Revegetation Research Plots

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In support of the Area 8, Phase I tree revegetation research project, Miami University and Ohio University personnel surveyed three plots adjacent to the planned restoration area on July 9, 10, 18, and 19, 1998 (Figure 1). Table 1 provides the sample data for the three plots. Plot No. 3 was mapped to understand the local natural spacing pattern of lowland forest stems. Mapping involved determining the actual distribution of each live stem greater than 1 cm in diameter within the plot. This plot revealed exactly 102 individual stems that were even-aged in origin and low in diversity (14 species were present, five were dominant or co-dominant). Based on these findings, the planting plan for the eight research plots was revised as follows.

The original work plan proposed two plots of 500 seedlings, two plots of 250 seedlings and 50 saplings, and two plots of 500 seedlings and 100 saplings. These total to 2,500 seedlings and 300 saplings. As a result of the reference plot data, the planting mix was altered to include two plots of 100 saplings, two plots of 50 saplings and 600 seedlings, and two plots of 600 seedlings only. This totals 300 saplings and 2,400 seedlings, 100 less than the original work plan. This revised design is discussed in more detail below.

First, we plan to plant two of the study plots with 100 even-aged saplings of five species. The stands immediately adjacent to the planting areas are early successional forests containing mostly weedy tree species; however four of the five species that we are planting were present in the surveyed stands (Table 1). A minor adjustment was also made in the species composition to account for availability in the local nursery stock (green ash substituted for blue ash). The final species composition reflects the distribution found in a mature, relatively undisturbed lowland forest adjacent to Paddys Run which was surveyed and evaluated by Dr. Brian McCarthy. Three of the five species that we are planting; Ohio buckeye, chinqapin oak, and black walnut, are long lived hardwood species that will eventually become an excellent food source for wildlife. The remaining two species, hackberry and green ash, are hardy species often found in disturbed areas. They were very plentiful in the adjacent wooded area which was mapped.

Next, two mixed plots (saplings and seedlings) will be established to better mimic a multidimensional uneven-aged structure found in mature forests. These forests always contain a relatively low density of mature species and a high density of reproducing recruits. Because of the land use history throughout FEMP, we were unable to secure a site to estimate seedling density, so approximations from the literature for lowland forest sites were used. Thus there is a low density of saplings and a high density of seedlings.

The third approach involves two plots containing only seedlings. These plots are designed to mimic standard restoration efforts and to examine if present practices are sufficient. We are hypothesizing that the planting of seedlings without follow up management would not be sufficient, since they provide only one structural layer, are in heavy competition with herbaceous plants, are under heavy browsing pressure, are susceptible to drought and winter kill, and they suffer high mortality at any time of the year.

The effectiveness of several types of deer control techniques will be investigated in each plot with seedlings. One third of the seedlings from each plot (200) will be placed inside of a tree tube to determine if survival is enhanced. The second third of seedlings will be sprayed with a commercial deer repellent. The last set of 200 seedlings in each plot will not be protected as a control. Because of the immediate protection from browsing animals, increased humidity and carbon dioxide levels, we will most likely see reduced mortality and increased growth rates when compared to seedlings without tubes. However, the use of tubes quadruples the cost of planting seedlings because of increased materials and labor. Part of the econometric aspect of this study is to evaluate cost versus performance in order to make recommendations for future restoration efforts at FEMP.

The two control plots will provide areas in which to monitor successional changes in the vegetation and the natural establishment rate of woody species. The control plots will be monitored twice a year (Spring and Fall) and new tree recruits within the control plots will receive tree tubes to protect them from herbivore damage.

Figure 2 shows the location of the eight plots. The plots were randomly placed within the study area in order to avoid the appearance of a grid. In addition to the current research effort, this area will provide wildlife viewing opportunities for the Ecological Restoration Park. Table 2 lists the planting plan for each plot.

Figures 3 and 4 show the planting distribution for the five different sapling species, both for the sapling only and the sapling/seedling plots. Seedlings will be planted in accordance with the randomized design shown on Figure 5. A 10x10 m grid system was generated by programming a randomization routine to assign stems to X,Y coordinates. There will be ten such sub-grids within each 20x50 m plot. The sub-grid will be randomly rotated for all ten areas within a plot in order for the plantings to be statistically random. The five different shadings on the Figures represent the five different sapling species that will be planted. The five species have not yet been assigned a shading designation. This will be done once the plots have been flagged in the field and the supplying nursery contacted to color-code the saplings upon delivery. As stated above, the mapped reference site did not determine what specific species to be planted, but rather what densities and distributions to use.

The experimental design of the study will also allow us to compare natural succession (in the control plots), with our restoration efforts. The three experimental treatments (saplings only, seedlings only, and saplings plus seedlings), will allow us to determine if there is any benefit to planting a few large trees amongst the seedlings. There is a considerable bank of literature which indicates that large trees may act as "perches" and "safe sites" which encourages birds and other animals to visit the area. Many of the tree species found in early successional stands are bird and animal dispersed. It will be interesting to see if the presence of the large trees accelerates the successional process. The saplings may also tend to modify the climate around the seedlings which may also help to promote their establishment. On the other hand, perches might promote the establishment of non-native invasive species. Again, econometric considerations will be evaluated with respect to the overall benefit of the various approaches.